STATE OF MINNESOTA
OFFICE OF THE ATTORNEY GENERAL
ST. PAUL 55155

WARREN SPANNAUS
ATTORNEY GENERAL

August 18, 1982

ADDRESS REPLY TO:
ATTORNEY GENERAL'S OFFICE
POLLUTION CONTROL DIVISION
1935 WEST COUNTY ROAD B-2
ROSEVILLE, MN 55113
TELEPHONE: (612) 296-7342

Edward J. Schwartzbauer
Dorsey & Whitney
2200 First Bank Place East
Minneapolis, MN 55401

Gary Macomber
Popham, Haik, Schnobrich, Kaufman
& Doty, Ltd.
4344 IDS Center
80 South 8th Street
Minneapolis, MN 55402

Re: U.S. v. Reilly Tar & Chemical Corp.
File No. Civ. 4-80-469
Water Treatment Study

Gentlemen:

As each of you have requested, enclosed is a copy of the draft contract for the Reilly Tar/St. Louis Park water treatment study. This draft is currently under review by CH_2M Hill and will hopefully be executed within a few days.

Any comments or suggestions which you may have on the proposed work would be welcomed.

Very truly yours,

STEPHEN SHAKMAN
Special Assistant
Attorney General

SS:mah

Enc.

cc: Michael J. Hansel, MPCA
Regulatory Compliance Section
Paul Bitter, EPA
Erica Dolgin, DOJ

511222

ATTACHMENT A

1. NOTICE TO CONTRACTOR. You are required by Minnesota Statutes, 1981 Supplement, Section 270.66 to provide your social security number or Minnesota tax identification number if you do business with the state of Minnesota. This information may be used in the enforcement of federal and state tax laws. Supplying these numbers could result in action to require you to file state tax returns and pay delinquent state tax liabilities. This contract will not be approved unless these numbers are provided. These numbers will be available to federal and state tax authorities and state personnel involved in the payment of state obligations.

2. Reimbursement for travel and subsistence expenses indicated in Clause II.A.2. shall be made in the same manner and in no greater amount than provided in the current "Commissioner's Plan" promulgated by the Commissioner of Employee Relations.

3. AFFIRMATIVE ACTION. Contractor certifies that it has received a certificate of compliance from the Commissioner of Human Rights pursuant to Minnesota Statutes, 1981 Supplement, Section 363.073. (See page A-4)

4. WORKERS' COMPENSATION. In accordance with the provisions of Minnesota Statutes, 1981 Supplement, Section 176.182, the state affirms that contractor has provided acceptable evidence of compliance with the workers' compensation insurance coverage requirement of Minnesota Statutes, 1981 Supplement, Section 176.181, Subdivision 2. (See page A-5)

5. ANTITRUST. Contractor hereby assigns to the state of Minnesota any and all claims for overcharges as to goods and/or services provided in connection with this contract resulting from antitrust violations which arise under the antitrust laws of the United States and the antitrust laws of the state of Minnesota.

6. The state shall promptly review all necessary submittals, and respond within one week from submittal; unless the state's authorized agent notifies in writing that a longer time to respond is required.

7. The state shall assist or shall arrange for the city of St. Louis Park to assist in the startup and operation of wells during sample acquisition and test work.

8. State shall define treated effluent discharge limitations. No study tasks are included for formulation of alternative discharge standards by contractor.

9. The state shall install or shall arrange for the city of St. Louis Park to install sampling taps at the treatment system at existing Well No. SLP-15 at all appropriate locations for the completion of Project Element E.

10. State shall provide staff or arrange for city staff to be available to spot check the pilot testing facilities during the off shifts. Contractor shall prepare a detailed time estimate and schedule and submit to the state at Task I.

11. Upon request the state shall provide copies of all reports, documents, test data, and other information it possesses, which pertain to this project.

12. The contractor shall hold all information provided by the state as confidential and no such information shall be released to any other parties or the public, except upon prior approval from the state's authorized agent. No such information shall be used for purposes other than those specified in this contract.

13. Contractor recognizes that work performed under this contract and other remedial measures which may be undertaken concerning soil and ground water contamination from the former Reilly Tar site are the subject of pending litigation by several governmental agencies against the Reilly Tar and Chemical Corporation. Contractor also recognizes that it, its employees, subcontractors, and agents may be called upon to testify as to the work performed under this contract.

14. Any communications with government attorneys working on the lawsuit mentioned above, or with others working on the lawsuit in cooperation with the government attorneys, shall constitute trial preparation material and shall not be disclosed without the consent of those attorneys.

15. The contractor shall obtain prior approval from the state's authorized agent prior to the release of any documents or the making of any communication to any other parties or the public relative to work under this contract.

16. Contractor agrees to advise employees, subcontractors, and agents working on this contract of the information contained in 12, 13, 14, and 15 above.

III. CONDITIONS OF PAYMENT. All services provided by Contractor pursuant to this contract shall be performed to the satisfaction of the state, as determined in the sole discretion of its authorized agent, and in accord with all applicable federal, state and local laws, ordinances, rules and regulations. Contractor shall not receive payment for work found by the state to be performed in violation of federal, state or local law, ordinance, rule or regulation. Contractor shall be responsible, to the level of competency presently maintained by other professional engineers performing work of similar nature, for the professional and technical soundness, accuracy, and adequate of all designs, drawings, and other work and materials furnished under this contract. The Contractor makes no other warranty express or implied.

IX. LIABILITY. Contractor agrees to indemnify and save and hold the state, its agents and employees harmless from any and all claims or causes of action arising from the negligent performance of this contract by contractor or contractor's agents or employees. This clause shall not be construed to bar any legal remedies contractor may have for the state's failure to fulfill its obligations pursuant to this contract. The contractor and the state intend the drawings, plans, schedules, specifications, calculations, reports, and designs prepared by contractor under this contract to be used in the remedy of the soil and ground water contamination in St. Louis Park, Minnesota, and other communities to which that contamination may spread. Any other use of these drawings, plans, schedules, specifications, calculations, reports and designs by the state shall be at its own risk.

STATE OF MINNESOTA
DEPARTMENT OF HUMAN RIGHTS
[illegible] FLOOR
7[illegible] PLACE E. [illegible]
ST. PAUL, MINNESOTA 55101
• (612)296-5663 • SAINT PAUL, MINNESOTA 55101

October 12, 1981

Mr. Philip R. Devlin
CH2M Hill Central, Inc.
2929 N. Mayfair Road
P.O. Box 2090
Milwaukee, WI 53201

Dear Mr. Devlin:

This letter acknowledges receipt of your application for a Certificate of Compliance issued by this department pursuant to Minnesota Statutes 363.073.

The Minnesota State Legislature has recently passed new legislation in the area of contract compliance for state contractors and vendor/suppliers.

Previously, all contractors, vendors, and suppliers who bid on state contracts exceeding $2,000.00 were required to have a certificate of compliance issued by the Department of Human Rights. Specific information was requested of the business on department forms and contractors were issued a certificate.

As a result of the new compliance law, firms or businesses seeking to do business with the state will still be required to have a certificate of compliance. However, if the contract is less than $50,000.00 or the company has less than 20 employees, a certificate of compliance will not be required. Those businesses or firms with more than 20 full time employees who's bid exceeds $50,000.00 will be required to have an Affirmative Action Plan approved by the Commissioner of the Department of Human Rights in order to obtain a certificate of compliance.

The department is presently in the process of developing rules and regulations for the administration of the new legislation pertaining to contract compliance. Temporary rules will soon be adopted and used until the permanent rules become effective in a few months.

Until the new rules and regulations become effective your application for a certificate of compliance will be kept on file. Your status will be that of having a pending application. This will allow you to continue to do business with the state.

If you have any questions regarding this matter please call James Robinson, 296-5683 or Melanie Brandon, 296-1373 of the Compliance Unit.

Sincerely,

James Robinson

James Robinson
Compliance Supervisor

JR/epr

511226

CERTIFICATE OF INSURAN E

In effect on date of this certificate arranged by

[illegible]

1200 westlake ave. no seattle, washington 98109

This is to certify that the insurance described below has been arranged for the insured designated in this certificate. Any requirements or provisions in any contract or agreement between the insured or any other person, firm or corporation will not be construed as enlarging, altering or amending the definition of insured or any other terms or conditions of this certificate or the insurance designated. Such insurance, subject to the limits of liability, coverages, hazards, exclusions, provisions, conditions and other terms thereof, is in full force and effect as of the date this certificate was issued.

Insured: CH2M HILL, INC.

Address: 1600 S.W. Western Blvd., P.O. Box 428
Corvallis, OR 97339

Bodily Injury Liability Insurance — Other Than Automobile

Primary Insurer _____ Expires _____ Pol. No. _____

Limits $ _____ Each Person $ _____ Each Occurrence $ _____ Aggregate

Bodily Injury Liability Insurance — Automobile

Primary Insurer _____ Expires _____ Pol. No. _____

Limits $ _____ Each person $ _____ Each Occurrence

Property Damage Liability Insurance — Other Than Automobile

Primary Insurer _____ Expires _____ Pol. No. _____

Limits $ _____ Each Occurrence _____ Aggregate

Property Damage Liability Insurance — Automobile

Primary Insurer _____ Expires _____ Pol. No. _____

Limits $ _____ Each Occurrence

Workmens Compensation (Minnesota)

Insurer: Mission Insurance Company Expires: 08/15/83 Pol. No. 48WC5205516

Emp. Liability Limit: 500,000 Each Accident

Excess Liability Insurance

Insurer _____ Expires _____ Pol. No. _____

Limit A $ _____ combined single limit in excess of above described underlying limits

Limit B $ _____ combined single limit in excess of above described underlying limits

In accordance with the above, the insurance covers the operations and locations described as follows:

Operations of Insured

In the event of cancellation of said Policies 30 days notice of such cancellation will be given the party named below at the address shown herein.

The policy provides under the Insuring Agreements contractual liability coverage with respect to any contract or agreement wholly in writing, subject to all the exclusions, conditions and other provisions of the policy.

This certificate is not a policy and does not afford any insurance coverage. Nothing contained in this certificate shall be construed as extending coverage not afforded by the designated insurances or by endorsement thereto. Except as specifically provided for in this certificate, the insurers shall have no duty to notify the party to whom this certificate is addressed as to any change in, or cancellation of, the insurances and shall not be responsible for any failure to do so.

511227

Date: June 30, 1982

To: Minnesota Pollution Control Agency
Solid & Hazardous Waste Division
1935 West County Road, B2
Roseville, Minnesota 55113
Attn: Mr. Michael J. Hansell

[illegible]

BY John P. Doran

John P. Doran

ATTACHMENT B
Contractor's Duties

1. The scope of work is divided into 21 major tasks, (A through U), described in detail below. Contractor shall not initiate any work on Task H without written authorization from the State's authorized agent following the milestone review described in Task G. Contractor shall not initiate any work on Tasks J, K, and O without written authorization from the State's authorized agent following the milestone review described in Task I. The State reserves the right at its sole discretion to cancel Tasks H, I, J, K, and O. In the event these tasks are cancelled, no compensation for these tasks, or preparation therefore shall be due Contractor. In the event the scope of these tasks is reduced, payment will be made only for those services authorized by the State's authorized agent. The State shall notify the Contractor within five days of the completion of Task G if the Contractor is to initiate work on Tasks H and I. The State shall notify the Contractor within five days of the completion of Task I, if the Contractor is to initiate work on Tasks J, K, and O.

2. Contractor shall complete the scope of work in a timely manner and in accordance with the schedule in Attachment E.

3. Contractor shall perform the following tasks:

A. Literature Search

A-1 Immediately upon receipt of notice to proceed, Contractor shall institute a literature search of all appropriate literature on water treatment for the removal of PAH's, nitrogen and sulfur heterocyclic compounds, aromatic amines, phenolic compounds, and other coal-tar derivative contaminants. In addition to compiling literature available in Contractor's in-house library system, Contractor shall work through the University of Wisconsin-Milwaukee library to conduct a computerized literature search for appropriate information. The computer search shall be based on the "Engineering Index" and "Chemical Abstract" data bases and, if necessary, be expanded to additional data bases.

A-2 Contractor shall compile and review all appropriate literature identified in the literature search.

A-3 All of the identified literature references shall be summarized in an annotated bibliography.

B. Technology Assessment

B-1 Upon completion of the literature review, Contractor shall screen the cited references to summarize historical data appropriate to the specific problems at St. Louis Park. This screening of data shall be used to prepare a concise assessment of each individual treatment technology which has been investigated by previous researchers. This assessment of technologies shall then be summarized in a brief written description of the strengths and weaknesses of each

technology and a table(s) to illustrate comparative features of each technology. The comparison of technologies shall, at a minimum, include the following features:

- o State of development
- o Reliability of unit processes
- o Reported effluent concentrations of key pollutants
- o Relative capital cost
- o Relative operating and maintenance cost
- o Potential operating problems
- o Types and relative volumes of byproducts/residues/sludges generated by the process
- o Case histories of methods used for ultimate disposal of byproducts/residues/sludges generated

B-2 The technology assessment shall be summarized in a technical memorandum. Such memorandum shall be used as a working document during the project and shall be included as an appendix to the final report.

C. Document Sampling, Chain of Custody, and Analytical Procedures

C-1 Sampling, chain of custody, and analytical procedures are described in Attachment C. Contractor shall faithfully follow said sampling and analytical procedures.

C-2 Prior to the first round of well sampling (task D-1) Contractor shall perform a special round of method validation analyses. Seven aliquots of laboratory water shall be spiked at 4 ng/l (with all targeted PAH's except those present in the water supply) and tested in accordance with the analytical procedures described in Attachment C. The results of these analyses, along with test work already completed by the Contractor prior to contract approval, will be used to document the detection limit of the test protocol.

C-3 During the first round of well sampling, three well water samples shall be split for duplicate analysis by the Minnesota Department of Health (MDH). Contractor shall also split these samples with a laboratory specified by the U.S. EPA. Analyses by the two laboratories shall be evaluated to verify whether ongoing test work is comparable with historical test work. Contractor shall not bear the cost for shipment and analysis of split samples by MDH and U.S. EPA.

D. Conduct Well Sampling and Analysis Program

D-1 Immediately upon receipt of notice to proceed, Contractor shall obtain water quality samples from Well Nos. W2, W13, W100, W70, W112, Hopkins No. 3, and municipal Well Nos. 4, 5, 7, 9, 10, and 15. Existing municipal pumps will be used to sample municipal wells and other wells will be sampled with a portable pump provided by the Contractor. Water pumped from the above wells shall be disposed at the direction of the State. (No costs for disposal are included

in the Contract costs.) All samples will be shipped to Contractor's laboratory and will be analyzed for base neutral and acid fraction compounds using sampling and analytical procedures described in Attachment C. Volatile fractions will be analyzed for Well No. 13 and municipal Well Nos. 10 and 15 to better characterize other organics (first round sampling only). All samples shall be analyzed for PAH, nitrogenous heterocyclic, sulfur heterocyclic, aromatic amines, and phenolic compounds.

Contractor shall measure dissolved oxygen and temperature in all wells in the field at the time of sampling.

The sample from municipal Well No. 15 shall also be analyzed for the following inorganic constituents: pH, ammonia, iron, magnesium, manganese, carbonate, and sulfate.

D-2 Contractor shall obtain an additional 4-liter sample from each of the above wells. Each sample shall be extracted as described in Attachment C, and either the extract shall be preserved, sealed and frozen, or the extract shall be dried to residual solids, and the solids sealed and stored. (This 4-liter sample will be used by the state for toxicological studies.)

D-3 At the time water samples are obtained for bench-scale test work (Task H), Contractor shall obtain samples from each of the above wells. Samples will again be analyzed for base neutral and acid fraction compounds, using the sampling and analytical procedures described in Attachment C. Contractor shall measure dissolved oxygen and temperature in all wells in the field at the time of sampling. All samples shall be analyzed for specific PAH, nitrogenous heterocyclic, sulfur heterocyclic, aromatic amines, and phenolic compounds.

D-4 Historical test results on water samples from the above wells will be compiled and compared with results from the first two rounds of sampling and analysis. Trends and/or significant differences in water quality will be assessed.

D-5 At the beginning of pilot scale test work (Task K), water samples will be obtained from Well No. W13 and municipal Well Nos. 10 and 15. Samples will again be analyzed for base neutral and acid fraction compounds, using the sampling and analytical procedures described in Attachment C. All samples shall be analyzed for specific PAH, nitrogenous heterocyclic, sulfur heterocyclic, aromatic amines, and phenolic compounds.

D-6 Following analysis of all historical test data and data obtained during this study, water quality at each of the wells identified above shall be characterized. Average concentrations and potential fluctuations in the concentrations of PAH, nitrogenous heterocyclic, sulfur heterocyclic, aromatic amines, and phenolic compounds shall be summarized. These projections of water quality at each well shall serve as design criteria for sizing and estimating the costs of water treatment systems at the wells and/or for projecting concentrations of water discharged to the sewer system or surface water.

E. Investigate Existing Treatment at Well No. SLP-15

E-1 One set of samples shall be obtained to assess the effects of the existing water treatment system at Well No. SLP-15. The samples shall be obtained at the same time Task D-1 is completed, and shall be analyzed for base neutral and acid fraction compounds using sampling and analytical procedures described in Attachment C. During this sampling event, each of the following locations shall be tested:

- o Sample at well head
- o After aeration
- o After sand filtration
- o After chlorination
- o In storage after two mutually selected retention times (minimum and maximum anticipated retention times)

If data obtained during this test work indicates any significant destruction of phenolic compounds, Contractor shall carefully analyze the data to determine whether any chlorinated phenolic byproducts are generated.

If the test work indicates significant destruction of PAH or other compounds, Contractor shall submit written recommendations on modifications and/or additions to the pilot testing program to test the treatment of both raw water and treatment system effluent.

F. Prepare Bench-Scale Testing Program

F-1 Following completion of project Elements A, B, C, D, and E, Contractor shall prepare a detailed outline of recommended bench-scale test work to be completed and procedures to be used during this study. Contractors preliminary assessment of required bench-scale testing is described below. Appropriate modifications shall be made to this preliminary program as dictated by results of Tasks A through E.

BENCH TEST PLAN

Sampling

Approximately 300 gallons of representative well water shall be obtained from Well No. SLP-15 and shipped in teflon lined drums to Contractor's Montgomery laboratory. A smaller sample shall be taken at the site, preserved, and air freighted to Montgomery for immediate analysis. The results shall be compared to similar analyses from each drum to detect any sample degradation in transit (none is expected).

UV/Ozone

A 10-liter bench reactor and a 2-lb/day ozonator shall be rented from Westgate Research Corp. and batch tests shall be run at various times, ozone concentrations, UV dosages, pH, and temperature

levels. Both air and oxygen generated ozone shall be tested. Initial tests shall be run at severe conditions (e.g., one hour, 3 percent ozone, oxygen-ozone, full UV, 100°F, pH=10) to screen feasibility. If insufficient removal occurs after two repetitions, the technology may be discarded.

As UV light can cause retinal damage unless screened out by glass. Lab personnel shall wear protective glasses. Ozonation and reactor vents shall be passed through a catalytic decomposer and discharged.

UV/Peroxide

Although UV/ozone is a stronger oxidant, UV/peroxide is more economical. If UV/ozone is ineffective, a single UV/peroxide demonstration test shall be run at severe conditions (unless unexpectedly good results occur). Metal catalyst (probably iron) shall also be considered. The test reactor shall be identical to that used for UV/ozone with a different oxidant sparger.

Chlorine dioxide

As it is not expected that chlorine dioxide will be as effective as ozone, a demonstration jar test shall be run for completeness only.

While it is difficult to predict how extensive the bench test work will be regarding oxidants, it is assumed that UV/ozone will require full evaluation, and that peroxide and chlorine dioxide will be screened out. A total of 20 batch tests shall be performed, as dictated by results of the first several tests.

Granular Activated Carbon (GAC)

Contract shall develop adsorption isotherms (graphical plots of mg adsorbed/gm carbon versus residual concentration) for five different carbons at two pH's, and for one carbon at two temperatures; ambient groundwater temperature and one other. Large, constant temperature baths and stirrers shall be used to provide a large enough sample for analysis.

Contractor shall determine leaching from the five different carbons at two pH's, and for one carbon at two temperatures by testing water that is known to be free of PAH as a blank and analyzing for base neutral and acid fraction compounds, using the sampling and analytical procedures described in Attachment C.

Contractor shall operate a 2½-inch diameter by 40-inch bed depth bench-scale carbon column using the most promising carbon from the isotherm tests. Contractor shall monitor one (1) run over a 100-bed volume throughput to demonstrate feasibility. If obvious breakthrough occurs, the need for additional runs on other carbons shall be discussed with state.

Contractor shall contact regeneration vendors regarding potential for PAH or dioxin-like compounds in carbon regeneration off-gases. The information gained from these sources, coupled with our literature search, shall be used to determine the need for stack sampling during regeneration of pilot test carbon. Contractor shall obtain approval from State's authorized agent before proceeding with such test work.

Macroreticular Resins

Contractor shall develop isotherms for three different resin at two pH levels at ambient groundwater temperature. One (1) column test on the most promising resins will be run, similar to the GAC test, in a 2½-inch resin column. Partially spent resin from this run shall be washed and percent regeneration shall be calculated on a TOC basis. The contaminated regeneration shall be batch distilled, and percent recovery estimated. Physical properties of the residuum shall be noted.

Ultrafiltration

The bench test apparatus shall consist of a mixed pressure cell, alternative membranes, and an air supply. Three different membrane types shall be tested. Concentrates shall be inspected for micelle formation.

Reverse Osmosis

Three different RO membranes shall be tested using the same apparatus at higher pressures. Salt permeability will be tested along with PAH removal to allow calculation of recovery rates. Three batch RO tests shall be run.

Series Treatment

Combinations of the above technologies could be of interest to the State under the following circumstances:

- o Removal of all PAH's to low mg/l levels may not be possible with any one technology.
- o Successful PAH destruction could be accompanied by formation of undesirable byproducts.
- o Treatment of contaminated concentrates may be required.

If bench tests indicate that combinations of the above technologies show promise, Contractor shall recommend further testing using technologies in series, such as oxidation followed by adsorption, or UF with oxidation of concentrates and recycle, etc. Such testing is not included as part of the contract, and shall not be undertaken without written approval by the State.

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G. Milestone Report/Review - Well Analyses and Proposed Bench-Scale Program

G-1 Tasks A through F shall be summarized in an interim report which shall be submitted to the State's authorized agent 5 days prior to the meeting in Task G-2.

G-2 Contractor shall set up and attend a milestone review meeting with the State's authorized agent and other parties which are designated. The results of all work tasks and recommendations shall be presented and discussed. Bench-scale test work (Task H) shall not be initiated without written authorization from the State.

H. Bench-Scale Testing

H-1 Bench-scale tests, as prepared in Task F and discussed with the State in Task G, shall be conducted in Contractor's in-house laboratory.

H-2 All bench-scale test work and analyses shall be summarized in a technical memorandum. This memorandum shall be used as a working document during the project and shall be included as an appendix to the final report.

I. Milestone Review Meeting - Review Bench-Scale Results

I-1 Draft copies of the technical memorandum prepared in Task H-2 shall be submitted to the State's authorized agent 5 days before the meeting described in Task I-2.

I-2 Contractor shall set up and attend a milestone project review meeting with all appropriate parties to discuss the results of the bench-scale testing program. Pilot scale test work (Tasks J and K) shall not be initiated without written authorization from the State's authorized agent.

J. Prepare Pilot Testing Program

J-1 Based on the bench-scale testing results as discussed with the State in Task I, Contractor shall prepare and submit a plan for onsite pilot scale testing at St. Louis Park. The pilot testing plan shall, at a minimum, address:

- o Number and length of test runs
- o Number of samples to be taken and analyzed
- o Assessment of short-term perturbations in influent/effluent stream water qualities

J-2 The pilot scale testing program shall be submitted to the State for written approval. Pilot scale test work (Task K) shall not be initiated without written authorization from the State. The State shall review the proposed project schedule and plan, as prepared in Task J-1, in one (1) week.

K. Pilot-Scale Testing

K-1 Pilot scale tests, as prepared in Task J-1 and approved by the State in Task J-2, shall be conducted at St. Louis Park, as described below.

PILOT TEST PLAN

Contractor shall work closely with the State throughout the bench testing program to develop a clear consensus regarding technology feasibility and the need for pilot testing. Upon written approval to proceed, Contractor shall develop a detailed pilot test plan defining the proposed equipment, staffing, logistics, duration, sampling protocol, analytical methodologies, safety and hygiene programs, and management strategy.

Since pilot testing will likely occur during cold weather, test apparatus shall be located in the water treatment facilities located adjacent to Well No. SLP-15. Desirability of testing more than one well shall be assessed. Utility requirements (power and water) shall be defined. Data logging, reduction and evaluation techniques shall be described. Requirements for well operation shall be defined, and disposal plans shall be detailed for process wastes (concentrates, regeneration solutions, untreated well water, and contaminated equipment).

Depending on the complexity of the testing program, an onsite computer terminal may be provided for easy data logging and manipulation, and for instantaneous communication with Contractor's Milwaukee office. Test equipment may be either leased or purchased, depending on economics. If purchased equipment is used, of if any facilities are constructed specifically for this pilot program, they shall become the property of the State after test work is completed.

Based on a relatively large amount of successful experience in the removal of refractory non-polar aromatic organics, Contractor has assumed for purposes of preparing this contract that GAC will be selected for pilot testing at Well No. SLP-15. This assumption shall be verified at the conclusion of the bench testing program at Task I.

Four 6-inch diameter by 8-foot glass columns, each containing 6 feet of carbon shall be used. Five intermediate sample taps shall be provided to allow calculation of contact time, bed depth, carbon dosage, breakthrough curves, flow velocities, and headloss characteristics. Downflow operation is assumed. Backwash provisions shall be made. If earlier calculations regarding breakthrough on bench-scale columns are correct, breakthrough would not occur for several weeks and perhaps several months. The contract is based on a 30-day run on four columns (with four separate carbons) at the optimum pH determined from isotherm evaluations.

Contractor shall provide a full-time onsite staff member. Samples shall be preserved and air freighted to Contractor's Montgomery laboratory for analysis using the sampling and analytical procedures described in Attachment C. Contractor shall develop a correlation between TOC and/or other simple laboratory tests and PAH removal to allow quick response to daily operating fluctuations using laboratory scale tests. Such laboratory scale tests shall be used to define on-line instrumentation for measurement of raw and product water quality in the full-scale treatment system(s).

During the 30-day test run, it is assumed that effluent from each of the four carbon columns will be sampled every third day and shipped to the laboratory and analyzed for base neutral compounds. The last set of samples would be tested for acid and volatile fractions as well.

It is not likely that any of the four columns will reach break through in the 30-day test period, but budgetary constraints do not permit operation of the columns for extended periods of time. Depending on the outcome of the 30-day test runs, it may prove desirable to run one or more of the columns to breakthrough. Even if testing frequency were reduced to one sample per week, an extended test run would add substantially to the project budget. Testing of optimum carbon dosages, contact time, and flow rates would likewise be difficult to test within the existing budget.

Since GAC is only one of several technologies which might be tested on pilot scale, the above testing program is adopted for budgetary purposes only. Depending on the technology(s) actually pilot tested, the pilot testing budget could change.

MONITORING WELL NO. 13

Treatability testing of Well No. 13 liquids deserves special attention. Contamination levels are five to six orders-of-magnitude higher than other wells, indicating that, on a total mass basis, there are at least 100 times more PAH in this 10-gpm flow than in the combined 5,500 gpm flow from all other contaminated wells. Also, the existence of three or four separate phases is probable in the well discharge: water, oil, emulsion, and suspended solids. Therefore, bench and pilot testing shall include pretreatment technologies, many of which are common in the oil refining, coke, and synfuels industries where similar wastes are more common.

Following the literature search, Contractor shall propose at least four alternative pretreatment systems for State review, including, but not limited to:

- Equalization, acid cracking, phase separation
- Same as above plus flocculation, sedimentation, and filtration
- Same as above plus dissolved air flotation and filtration
- Same as above plus UF

In these screening tests, oil and grease and TOC analyses shall be used according to U.S EPA protocols. A confirming GC/MS shall be run only on the most promising system effluent. The results will be discussed with the State as part of Task G. Further testing and/or investigation of concentrates/sludge disposal shall not be done without State approval, and is not included in this scope of work.

Because of the highly contaminated nature of the water in Well No. 13, Contractor shall employ special health and safety precautions at all stages of sampling, testing, and analysis, as described in Attachment D.

K-2 All pilot-scale test work and analysis shall be summarized in a technical memorandum. This memorandum shall be used as a working document during the project and shall be included as an appendix to the final report.

L. Review Alternative Water Supply Studies

L-1 The four water supply studies (3 city reports and Hickok, April 81) previously prepared by others shall be reviewed. The information available from the ongoing water supply study by the City of St. Louis Park shall also be reviewed. The primary emphasis of this review shall be to ensure that the cost estimates used for the alternative water supply options are consistent with the cost estimates used in this investigation.

L-2 As necessary, the cost estimates for the alternative water supply options as set forth in the city's studies shall be adjusted to be consistent with the unit costs used in this report. Any gaps in the city's assessment of options shall be identified, with particular attention to change in the city's water distribution system.

L-3 A technical memorandum shall be prepared that discusses and provides a cost estimate for each water supply option. This memorandum shall serve as a working document during the project and shall be included as an appendix to the final report.

M. Milestone Review Meeting - Review Pilot Testing and Water Supply Alternatives

M-1 Draft copies of the documents prepared in Tasks K-2 and L-3 shall be submitted to the State 5 days before the meeting described in Task M-2.

M-2 Contractor shall set up and attend a milestone project review meeting with the State's authorized agent and other parties which may be designated to discuss the results of the pilot-scale testing program and the review of alternative water supplies. A major point of discussion in this meeting shall be the preliminary screening of

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options to be evaluated in Tasks N through P. A maximum of ten (10) options shall be included for evaluation in Tasks N through P. Within five days of the conclusion of the meeting, the State shall determine whether to issue written approval to proceed with project Elements N through P.

N. Cost Estimates for Water Conveyance Systems

N-1 The piping options (gravity flow pipe, force main, and pumps needed in the conveyance of potable and wastewater for remedial pumping plans 1, 2 and 3, water collection and treatment schemes A, B, and C, and the effective water treatment alternatives from the 1981 Hickok report) to be investigated shall be identified and a representative route shall be selected for each option. Where there are obvious alternative routes that may significantly affect the cost, these alternative routes shall be included. Contractor shall contact staff from the appropriate city (e.g., St. Louis Park and Minneapolis) and major landowners (e.g., railroad) to define any major constraints with the construction of a pipeline along each route. Contractor shall also identify any constraints imposed by the storm or sanitary sewer system that is the discharge point for each route.

N-2 Pertinent technical information about each route shall be summarized. This information shall include, at a minimum:

- o Static pumping head
- o Total pumping head (estimated)
- o Length of various diameter pipe
- o Likely number of utility crossings (complexity of construction)
- o Pumping stations
- o Restoration
- o Special construction conditions (foundation soils, traffic, jacking, etc.)

N-3 Preliminary costs shall be estimated for each route using a series of unit costs suited to particular conditions along the route. The preliminary costs may be used to eliminate routes (but not options) that are obviously not cost-competitive.

N-4 The cost estimates for the remaining routes shall be refined with a more detailed analysis. The more detailed analysis shall include a review of utility maps to define any conflicts with existing utilities and further discussions with city staff. The resulting cost estimates shall be realistically indicative of the cost of constructing a conveyance system along each route. Unit costs used in this analysis shall be consistent with those used in the analysis of the other water supply options (Task L).

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N-5 A technical memorandum shall be prepared that summarizes the capital and operating costs of each optional conveyance system. The assumptions used in the cost estimates and the affect of any critical constraint on the estimated costs shall be discussed. This memorandum shall be used as a working document during the project and shall be included as an appendix to the final report.

O. Cost Estimates for Water Treatment Systems

O-1 Based on water treatment pilot scale test results from Task K and earlier assessment of well water quality, Contractor shall develop a series of treatment system flow diagrams and system sizing summaries.

A sufficient number of flow diagrams and sizing summaries shall be developed to assess the cost of water treatment at one level of PAH health risk for potable use and one level of health risk for discharge to surface water. Both localized systems at the well heads and a centralized treatment facility shall be developed.

The proposed flow diagrams shall include Contractor's recommendations for appropriate on-line instrumentation and/or recommended testing procedures to monitor raw and product water qualities.

O-2 A series of project specific cost estimating curves shall be developed for the unit processes selected for the effective treatment system(s) and applied to each of the systems developed in Task O-1.

These curves shall be used to estimate order-of-magnitude capital and O&M costs at different flow rates and contaminant levels. Cost data shall be developed from preliminary vendor estimates, recent Contractor full-scale installation cost information, and other information developed specifically for this project. Because of the highly project-specific features of the potential treatment alternatives, generalized cost curves from the literature may not be applicable.

In preparing annual O&M cost estimates, special attention shall be given to the special hygiene and health related costs associated with handling and disposing of potentially hazardous byproducts and the fact that all hazardous byproducts must be disposed of in accordance with State and EPA regulations for hazardous wastes. This issue will be of special importance in addressing the treatment/disposal of water from Well No. 13.

O-3 Contractor shall prepare an outline of the scope of work, schedule, and estimated engineering fees for the preparation of construction plans and specifications for each of the water treatment options outlined above.

P. Cost-Effective Analysis

P-1 Contractor shall prepare a cost-effective analysis for appropriate combinations including, but not limited to:

- o Alternative water supplies
- o Alternative pumping and conveyance combinations

- o Alternative water treatment system configurations (localized or centralized)
- o Alternative water treatment technologies at different levels of health risk

The cost-effective analysis shall be summarized for inclusion in the final report.

Q. Prepare Draft Report

Q-1 All information developed in the entire study shall be compiled and summarized in a draft version of a final report.

Q-2 Three copies of the draft report shall be submitted to the State 3 weeks before the final milestone review meeting to provide the State's authorized agent and other parties which may be designated adequate time for review of the draft report.

R. Milestone Review Meeting - Draft Report

R-1 Contractor shall set up and attend a final milestone project review meeting with the State's authorized agent and other parties which may be designated to discuss and solicit comments on the draft version of the final report.

S. Prepare Final Report

S-1 Following the final milestone review meeting, Contractor shall incorporate comments from the various parties into the final report and issue the report in final form. Three (3) copies of the report, one of which is a camera ready copy, shall be submitted to the State.

T. Project Administrative Tasks

T-1 Within 1 week following acceptance of this contract, Contractor shall attend a project kickoff meeting with the State to establish project communications.

T-2 Upon acceptance of the contract, Contractor shall submit a detailed work plan containing a schedule of activities and tentative dates for milestone project review meetings before initiating any work.

T-3 Contractor shall prepare monthly progress reports describing the activities of the project. At a minimum, the progress report shall describe:

- o Progress on individual project elements
- o General assessment of progress
- o Problems identified and recommendations for resolution (including impacts on estimated costs)
- o Projected progress during upcoming month
- o Summary of expenditures during the month

This report shall be submitted to the State 3 days prior to monthly meetings.

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T-4 Contractor shall attend a meeting with the State on the third Wednesday of each month. The project manager shall regularly attend such meetings, but additional people shall attend, if necessary.

U. Community Relations

Contractor shall participate in an initial and a final public meeting (approximately 8 hours each) to provide technical explanations and summaries of project tasks. As a part of Contractor's efforts, Contractor shall prepare visual aids (slides, flip charts, overheads, etc.) as necessary to explain and illustrate the proposed technical solutions at St. Louis Park.

GLT42/27

Quality Assurance Project Plan for the Measurement of PAH Compounds at ng/L Levels by Gas Chromatography/Mass Spectrometry

Prepared for CH_2M Hill

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3. PROJECT DESCRIPTION

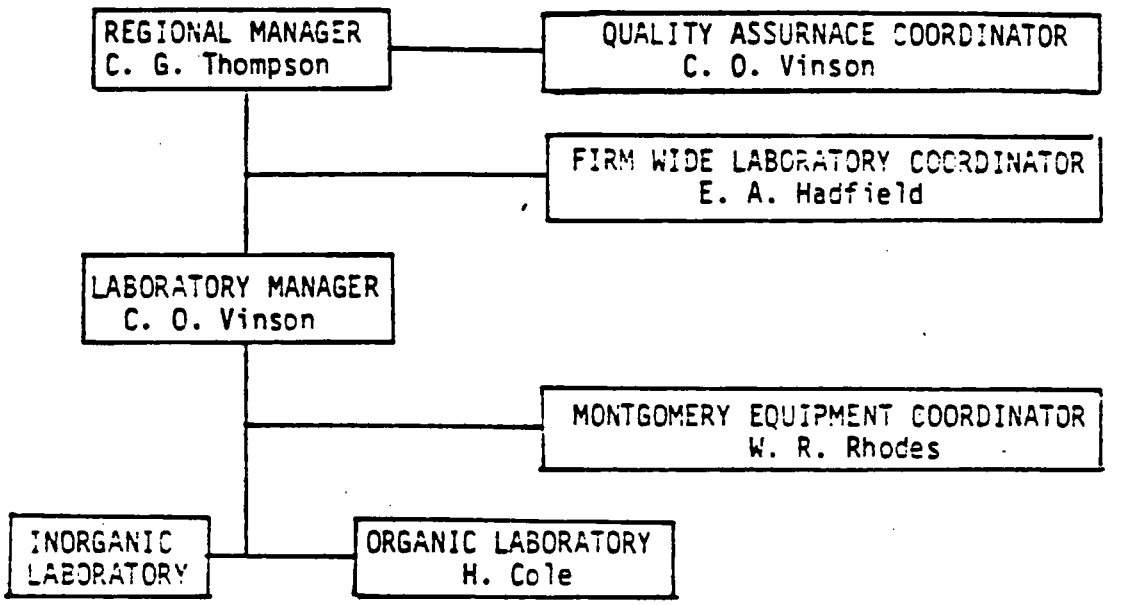
CH_2M Hill is to conduct a project to measure the PAH concentration at ng/L levels in:

- the ground water in the vicinity of Saint Louis Park, Minnesota,
- the influent, the effluent, and various stages of the existing treatment facility,
- various stages during a series of bench scale treatments,
- the influent and effluent of a pilot plant during a 30 day study.

The analytical procedure involves the serial extraction of the aqueous sample with methylene chloride at pH >11 and then pH <2, concentration, and analysis via capillary column gas chromatography/mass spectrometry (GC/MS).

The anticipated sampling schedule is given in Table 1. The target compounds are listed in Table 2. The PAH measurement data will be used to judge the treatability of the selected treatment process.

4. PROJECT ORGANIZATION AND RESPONSIBILITY



4.1 The Regional Manager will review all QA data with the Laboratory Manager on a quarterly basis.

4.2 The Laboratory Manager is responsible for the continuity and control of the QA program.

4.3 The Quality Assurance Coordinator is responsible for:

4.3.1 Logging samples and introducing control samples.
4.3.2 Monitoring QA activities.
4.3.3 Informing the staff and management of non conformance to the QA program.
4.3.4 Reviews purchased materials to ensure that quality materials are purchased.
4.3.5 Receives data prior to reporting and maintains QA documents.

5. QA OBJECTIVES FOR PAH MEASUREMENT DATA IN TERMS OF PRECISION, ACCURACY, COMPLETENESS AND METHOD DETECTION LIMITS

5.1 The QA objective for precision is an average relative range for duplicate analyses of less than 30% at a 95% confidence level. The preliminary validation study indicates that the relative standard deviation of laboratory control standards exhibits a slight concentration dependence (Figure 1).

5.2 The QA objective for accuracy is an average bias for the spiked samples of less than 25%. The preliminary validation study exhibited an average bias of -8% and -18% for 15 PAH compounds for true values of 10 ng/L and 50 ng/L respectively.

5.3 The QA objective for completeness is 90%. No more than 10% of the data is to be ruled invalid due to QA/QC checks on the overall system performance.

5.4 The QA objective for method detection limit (MDL) is an average MDL of less than 5 ng/L. The validation study gave an average MDL, for 15 PNAs, of 4.7 ng/L. (Table 3)

6. SAMPLING PROCEDURE

6.1 Method 624, purgeables, requires a duplicate sample to be collected and preserved with acid if analysis is to be performed between 7 and 14 days after collection due to the potential biological degradation of benzene, toluene, and ethylbenzene. If not acid preserved, the purgeable samples must be analyzed within 7 days.

6.2 The PNA compounds are susceptible to photodegradation, therefore, amber containers or foil wrapped containers must be used. Extraction must be completed within 7 days of collection. Extracts must be analyzed within 40 days of extraction.

6.3 Sample containers must be scrupulously cleaned. All sample containers are to be washed with detergent, rinsed with tap water, reagent water, and set aside to dry. PNA sample containers, after drying, are rinsed with a polar and a non-polar organic solvent and again set aside to dry before use.

6.4 Triplicates, duplicates and field blanks are included in each set of samples as scheduled on Table 1. The triplicate is collected at a clean well or at a treatment effluent. The duplicate is collected at a dirty well or at a treatment influent. The field blank is sent from the lab to the field and back to the laboratory with the other samples.

6.5 The composition of the duplicates and triplicates must be homogenous. Collect these samples in as short a period of time as possible. Fill each bottle of a duplicate or a triplicate set by sequential thirds to ensure homogeneity.

6.6 When sampling inactive wells, record the number of well volumes that have been pumped prior to filling an individual sample. A minimum of 10 casing volumes should be pumped before collecting a sample.

6.7 When sampling an active well, record the number of gallons pumped in the previous 24 hours.

6.8 The specific sample tag is illustrated in Figure 2.

6.9 Field records must be completed at the time the samples are collected. The records must be signed or initialed including the date and time by each member of the sampling team. A Field Tracking Report Form is given in Figure 4.

7. SAMPLE CUSTODY

7.1 Chain of custody procedures will apply to all samples. A chain of Custody Record form is given in Figure 5. All entries are to be completed in indelible ink. Dean Malotky is the field sampling team leader.

7.2 The original chain of custody record is sealed in a watertight plastic sandwich bag and shipped inside the sealed transportation case. A copy of the record is retained by the sampling team.

7.3 The samples are shipped to Harold Cole, the designated custodian at CH_2M Hill. A permanent log book will be kept describing the samples as received. Log book entries are to include; the person delivering the sample, date and time received, source of sample, sample ID or log number, mode of transport, and the condition of the sample as received.

7.4 Samples are to be stored in the custody room, a securely locked area. Only the custodian is to deliver samples to the laboratory personnel. The laboratory is to be maintained as a secured area, restricted to authorized personnel only. Laboratory personnel are responsible for the care and custody of the sample after being received from the custodian. The sample must always be in the possession or view of the laboratory personnel or secured in the laboratory at all times until analysis is completed.

7.5 The unused portion of the sample, if any, and all identifying labels must be returned to the custodian. The custodian will retain unused portions of the sample until the State's Authorized Agent, Michael J. Hansel, authorizes that the unused samples are to be destroyed.

8. CALIBRATION PROCEDURES AND FREQUENCY

8.1 The procedures for internal standard or external standard calibration are described in methods 624 and 625. The laboratory is responsible for demonstrating the linear range and the linearity of the calibration curve. If the concentration level of a target compound exceeds the linear range, the extract is diluted and reanalyzed for that compound.

8.2 The calibration of the GC/MS system is to be verified each day by 1) achieving the DFTPP or BFB key ion abundance criteria as appropriate, 2) achieving the benzidine or pentachlorophenol tailing factor criteria as appropriate, and 3) chromatographing an aliquot of the standard solution that contains the appropriate target compounds and updating the response factors if necessary.

8.3 Sources of the individual target compounds are given in Table 2. The source, purity, lot number, and certificate of true values for standard solutions will be recorded.

9. ANALYTICAL PROCEDURES

9.1 Method 624 is to be used without change for the analysis of the purgeable samples.

9.2 The PNA compounds are analyzed using a procedure developed at CH_2M Hill. This procedure is very similar to method 625 with the following exceptions:

9.2.1 Two surrogate standards are used instead of three.

9.2.2. The volume of the final extract is 0.02 mL instead of 1.00 mL.

9.2.3 The internal standards are added just prior to the final concentration, subsequent analysis is performed immediately after this concentration. Method 625 calls for adding the internal standards just prior to analysis.

9.2.4 The retention time agreement is to be ± 10 sec. instead of ± 30 sec.

9.2.5 The MDL for the priority pollutant PNAs average less than 5 ng/L. Method 625 gives an average MDL of 3200 ng/L for the priority pollutant PNAs.

10. DATA ANALYSIS, VALIDATION AND REPORTING

10.1 The area of each PNA internal standard (IS) is used to judge the validity of the assay step. The area of each PNA IS must be >20,000 counts. If the area is less than 20,000 counts, the GC/MS system must be retuned or the sample must be reanalyzed after additional concentration.

10.2 The recovery of the surrogate compounds is used to judge the validity of the sample processing steps. The surrogate standard recovery statistics are to be updated weekly to establish the control limits of $R \pm 3s$. The sample processing steps are valid if the recovery for the surrogate compounds falls within the control limits.

10.3 The equations in Section 7 and 15 of Method 625 are to be used to calculate the concentration of the target compounds. Report "not detected" if the calculated concentration is less than the MDL. Report the MDL concentration if the calculated concentration is between the MDL and two times the MDL. Report the concentration in µg/L for purgeables or in ng/L for the PNAs if the calculated concentration is greater than two times the MDL.

11. INTERNAL QUALITY CONTROL CHECKS

11.1 Field Blanks -- One field blank is included with each sample set. Once received back in the laboratory, the field blank is treated and an authentic sample and is used to monitor for contamination during transport and sampling.

11.2 Laboratory Blanks -- A laboratory blank is analyzed whenever a field blank indicates the possibility of contamination or whenever a new lot of solvents is first used.

11.3 Surrogate Standards -- All samples, including blanks, are spiked with the surrogate standards prior to extraction and are used to monitor the sample processing steps. The surrogate standards are 1-fluoronaphthalene and 2,4,6-tribromophenol..

11.4 Internal Standards -- All extracts are spiked with the internal standards just prior to the final concentration. The internal standards are d-8 naphthalene, d-10 anthracene, d-12 chrysene, 2-fluorobiphenyl, and d-5 phenol.

11.5 Duplicates and Spiked Samples -- The duplicate pairs are used to give overall precision of the data in both a relatively clean and a contaminated matrix. The third sample of the triplicate is used to give spiked recovery or accuracy data. The background concentration is the mean value from the two unspiked samples of the triplicate. Since the spiked samples should always be relatively clean samples, a constant amount (100 ng) of each target compound should be used in all spiked samples.

11.6 Refereed Samples -- Samples sent out to the referee laboratories should include a field blank and a triplicate so that interlaboratory precision and accuracy can be compared. Capsule Labs will analyze samples using GC/MS, (modified Method 625), the Minnesota Department of Health will analyze samples using HPLC (modified Method 610), and EMSL-Cincinnati will analyze samples using HPLC method 610 and GC/MS method 625.

11.7 Quality Control Check Samples -- The analytical laboratories must compare calibration standards with the EPA QC check samples at least once during this study.

12. PERFORMANCE AND SYSTEM AUDITS

12.1 Not applicable. No formal certification program or relevant interlaboratory performance evaluation study is available or planned for these compounds at the concentrations of interest. The data from the preliminary validation study will indirectly serve as the performance and system audits.

13. PREVENTIVE MAINTENANCE

Not applicable -- The system performance checks will show whether the participants' analytical systems are operable or not; the length of time necessary to do the required research does not warrant mandatory preventive maintenance programs. However, if any maintenance is performed - during the time frame of the project - then, that maintenance must be documented.

14. SPECIFIC ROUTINE PROCEDURES USED TO ASSESS DATA PRECISION, ACCURACY AND OUTLIERS

14.1 Precision -- The percent relative range (%RR) is used to assess the precision of the PAH measurements and is calculated using Equation 1.

Equation 1 $$\% RR = 2 * \frac{|X_1 - X_2|}{(X_1 + X_2)} * 100$$

Where: $|X_1 - X_2|$ is the absolute value of the difference between the duplicate results

The overall precision of the data set at the 95% confidence level is calculated from the average of all the %RR values using Equation 2.

Equation 2 $$\bar{P}_{95} = 2.51 * \frac{\sum_{i=1}^{n} \%RR_i}{n}$$

Where: $\%RR_i$ is each individual percent relative range
n = the number of duplicates

$\bar{P}_{95}$ = 95% confidence level of the average precision

14.2 Accuracy -- The accuracy of the data set is determined from the analysis of the spiked samples. The accuracy for each PAH compound is calculated using Equation 3.

Equation 3 $$A = 100 \frac{(Z - \bar{X})}{T}$$

Where: Z - is the analytical result in ng/L for the spiked sample

$\bar{X}$ - is the mean background concentration from the duplicate results

T - is the true value of the added spike

A - is the recovery for the added spike

The overall accuracy for each compound is the arithmetic mean over all the spiked samples, Equation 4.

Equation 4 $\bar{A}j = \frac{\sum_{i=1}^{n} Aij}{n}$

Where: Aij - is each recovery value for compound j

n - is the number of spiked samples

$\bar{A}j$ - is the average recovery for compound j

The 95% confidence level for each mean recovery is computed using equation 5.

Equation 5 $CL_{95} = \bar{A}_j \pm t(n-1, \alpha = 0.05) \cdot S$

Where: $t(n-1, \alpha = 0.05)$ is the appropriate two tailed students' t at $\alpha = 0.05$

S - is the standard deviation associated with $\bar{A}_j$

CL_{95} - is the upper and lower 95% confidence limits of A_j

14.3 Outliers -- An outlier is an extreme value, high or low, which has questionable validity as a member of the measurement set with which it is associated. Outliers may be rejected from the data set for the following reasons.

14.3.1 A known experimental aberration occurred, such as instrument failure or there was an inconsistency in the procedure or technique.

14.3.2 The t value for the datum is larger than the tabulated two tailed students' t for $\alpha = 0.05$ at n-1 degrees of freedom. The t value is calculated using Equation 6.

Equation 6 $t = \frac{(Xi - \bar{X})}{S}$

Where: X_i - is the extreme value being tested

$\bar{X}$ - is the mean of the measurement set for n observations

S - is the standard deviation associated with $\bar{X}$

If a value is rejected, the mean ($\bar{X}$) and standard deviation are recalculated using the remaining data. This procedure can be reiterated using the next extreme value until no outliers remain.

15. CORRECTIVE ACTION

15.1 Corrective action is initiated whenever the system is out of control. The following criteria are used to indicate out of control situations.

15.1.1 The area of a PAH internal standard is < 20,000 counts.

15.1.2 The recovery of a surrogate standard falls outside the range of R ± 3s when R is the mean recovery and s is its associated standard deviation. This range is from 70% to 118% for 1-fluorobiphenyl at the beginning of this study and should be updated on a weekly basis.

15.1.3 The percent relative range for a given analyte of a duplicate pair exceeds 40% and the range is larger than the MDL for that analyte. This control limit is calculated using Equation 2 but substituting 3.27 for the constant 2.51 and should be updated after every fifth duplicate pair is analyzed.

15.1.4 The recovery for a spiked sample falls outside the range of $A_j \pm t(n-1, \alpha = .01)*S$ where $t(n-1,\alpha = 0.01)$ is the 99% two tailed t value for n-1 degrees of freedom. This range is from 48% to 118% at for all compounds the beginning of the study and should be updated for each compound after every fifth spike sample is analyzed.

15.2 If the out of control situation is due to an instrumental problem, the sample is reanalyzed after corrective action is completed. Results from the out of control analysis are discarded if the new analysis gives values that are in control.

15.3 If the out of control situation is due to other than instrumental problems, all samples analyzed between the last in control and present out of control sample are declared suspect and should be reanalyzed to ensure the validity of the data. This is just the out of control sample for the criteria in sections 15.1.1 and 15.1.2, and all samples run since the last in control duplicate for the criterion section 15.1.3, and all samples run since the last in control spike sample for the criterion in 15.1.4.

15.4 A log will be kept describing the out of control situations and the corrective action taken to remedy the situation.

16. QUALITY ASSURANCE REPORTS TO MANAGEMENT

16.1 The analyst will identify and report any significant QA problems and recommend remedial steps to correct the problems.

16.2 At the end of the study, a report will be made that identifies the frequency of out of control situations and the necessary corrective action, the overall precision and accuracy of the data set, and the individual outliers.

TABLE 1

ANTICIPATED SAMPLING SCHEDULE

Sample Set	Source	No. of Samples	Field Blanks	Duplicate	Triplicate/Spike[a]
1	Wells (12) and existing treatment (6)	18	1	1	1
2	Wells (12) and bench test (6)	18	1	1	1
3	Bench test	18	1	1	1
4	Bench test	18	1	1	1
5	Bench test	16	1	1	1
6	Bench test	16	1	1	1
7	Bench test	16	1	1	1
8	Wells (3) and pilot test (4)	7	1	1	1
9	Pilot test	4	1	-	-
10	Pilot test	4	1	1	1
11	Pilot test	4	1	-	-
12	Pilot test	4	1	1	1
13	Pilot test	4	1	-	-
14	Pilot test	4	1	1	1
15	Pilot test	4	1	-	-
16	Pilot test	4	1	1	1
17	Pilot test	4	1	-	-
	TOTAL	163	17	12	12
	GRAND TOTAL	204 analyses			

[a] One of the triplicates is spiked at the lab to give the spiked sample.

TABLE 2

TARGET COMPOUNDS FOR GC/MS ANALYSES

Compound	CAS	IONS Primary	IONS Secondary	Source*
PNAs				
Acenaphthene	83-32-9	154	153,152	E,N,R
Acenaphthylene	208-96-8	152	151,153	E,N,R
Anthracene	120-12-7	178	179,176	E,N,R
Benzo(a)anthracene	56-55-3	228	229,226	E,N,R
Benzo(b)fluoranthene	205-99-2	252	253,125	E,N,R
Benzo(k)fluoranthene	207-08-9	252	253,125	E,N,R
Benzo(g,h,i)perylene	191-24-2	276	138,277	E,N
Benzo(a)pyrene	50-32-8	252	250,125	E,N,R
Benzo(e)pyrene	192-97-2	252	250,125	A,S
Chrysene	218-01-9	228	226,229	E,N,R
Dibenzo(a,h)anthracene	53-70-3	278	139,279	E,N
Fluoranthene	206-44-0	202	101,100	E,N,R
Fluorene	86-73-7	166	165,167	N,R
Indeno(1,2,3-cd)pyrene	193-39-5	276	138,277	N
1-Methylnaphthalene	90-12-0	142	141,115	A
2-Methylnaphthalene	91-57-6	142	141,115	A
Naphthalene	91-20-3	128	129,127	E,N,R
Perylene	198-55-0	252	250,126	A,S
Phenanthrene	85-01-8	178	179,176	E,N,R
Pyrene	129-00-0	202	101,100	E,N,R
Triphenylene	217-59-4	228	226,229	A
NITROGEN HETEROCYCLES				
Acridine	260-94-6	179	178,89	A,S
Carbazole	86-74-8	167	166,139	A,S
Indole	120-72-9	117	90,89	A,S
Phenanthridine	229-87-8	179	178,151	A
Quinoline	91-22-5	129	102,128	A

Table 2. Continued

Compound	CAS	IONS Primary	IONS Secondary	Source*
SULFUR HETEROCYCLES				
Benzo(b)thiophene	95-15-8	134	135,89	A
MISCELLANEOUS				
Biphenyl	92-52-4	154	153,76	A
2,3-Dihydroindene	496-11-7	118	119,91	A
Indene	95-13-6	116	115,89	A
AROMATIC AMINES**				

* E - EPA QC Check Samples
N - NBS SRM-1647
R - EPA Repository Radian
A - Aldrich Chemical, Milwaukee, WI.
S - Sigma Chemical, St. Louis, Mo.

** Up to 3; to be chosen after first round of testing.

TABLE 3

MDL DATA FROM VALIDATION STUDY

COMPOUND	SPIKE LEVEL ng/L[a]	MEAN	STD.DEV.	% RECOVERY	MDL[b]	F RATIO	MDL POOLED[c]	MDL
Naphthalene	25	20.1	3.71	80	11.7			
	10	9.3	1.40	93	6.4	7.02	8.8	8.8
Acenaphthylene	25	19.9	1.22	80	3.8			
	10	7.4	0.39	74	1.8	9.78	-	1.8
Acenaphthene	25	20.4	1.54	82	4.8			
	10	8.3	0.39	83	1.8	15.6	-	1.8
Fluorene	25	22.5	1.21	90	4.2			
	10	7.6	1.00	76	4.5	1.46	3.2	3.2
Phenanthrene	25	20.4	3.35	81	10.5			
	10	9.8	3.00	98	13.6	1.24	9.1	9.1
Anthracene	25	18.1	3.99	72	12.6			
	10	8.0	0.70	80	3.1	32.5	-	3.1
Fluoranthene	25	23.1	2.33	93	7.3			
	10	9.4	1.2	94	5.4	3.77	5.7	5.7

TABLE 3. continued

MDL DATA FROM VALIDATION STUDY

COMPOUND	SPIKE LEVEL ng/L[a]	MEAN	STD.DEV.	% RECOVERY	MDL[b]	F RATIO	MDL POOLED[c]	MDL
Pyrene	25	24.0	2.31	96	7.3			
	10	11.4	1.0	114	4.5	5.34	5.6	5.6
Benzo(a)anthracene	25	21.6	3.10	86	9.7			
	10	10.9	1.0	109	4.5	9.61	-	4.5
Chrysene	25	19.6	3.71	67	11.7			
	10	9.5	0.5	95	2.3	55.	-	2.3
Benzo(b)Fluoranthrene	25	22.0	2.81	88	8.8			
	10	10.9	0.2	109	0.9	197.	-	0.9
Benzo(a)Pyrene	25	17.8	5.48	71	17.2			
	10	8.3	0.96	83	4.4	32.6	-	4.4
Indeno(123,cd)Pyrene	25	20.3	2.39	81	7.5			
	10	8.8	0.9	88	4.1	7.05	5.7	5.7
Dibenzo(ah)Anthracene	25	19.7	2.78	79	8.7			
	10	9.2	1.2	92	5.4	5.37	6.7	6.7
Benzo(ghi)Perylene	25	19.9	2.66	80	8.4			
	10	8.9	.95	89	4.3	7.84	6.3	6.3
								Average 4.7

a) seven replicates at 25 ng/L, 4 replicates at 10 ng/L
b) Std. Dev. * 3.143 at 25 ng/L; Std. Dev * 4.541 at 10 ng/L
c) pool if F ratio less than 8.94

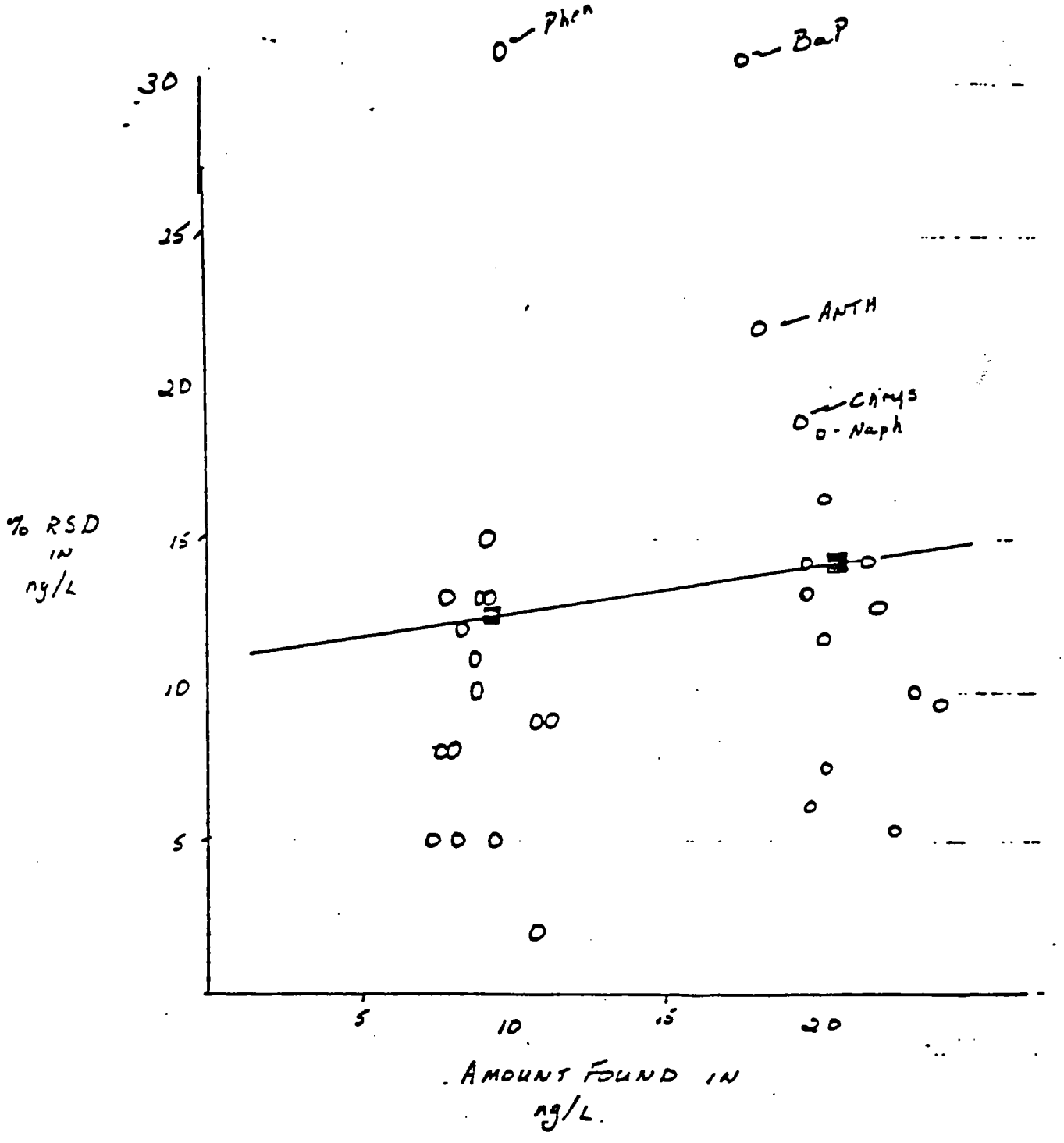


Figure 1. Relative Precision versus Concentration in the Validation Study.

CH2M HILL

PH. 205/834/2570
Montgomery, Office
807 South McDonough Street
Montgomery, Alabama 36104

CLIENT _____

SAMPLE NO. _____

LOCATION _____

_____

ANALYSIS _____

_____

PRESERVATIVE _____

DATE _____ BY _____

Figure 2. Sample Tag for Purgeables Sample.

W/O No. _____ Page____

FIELD TRACKING REPORT: _____-_____
(LOC-SN)

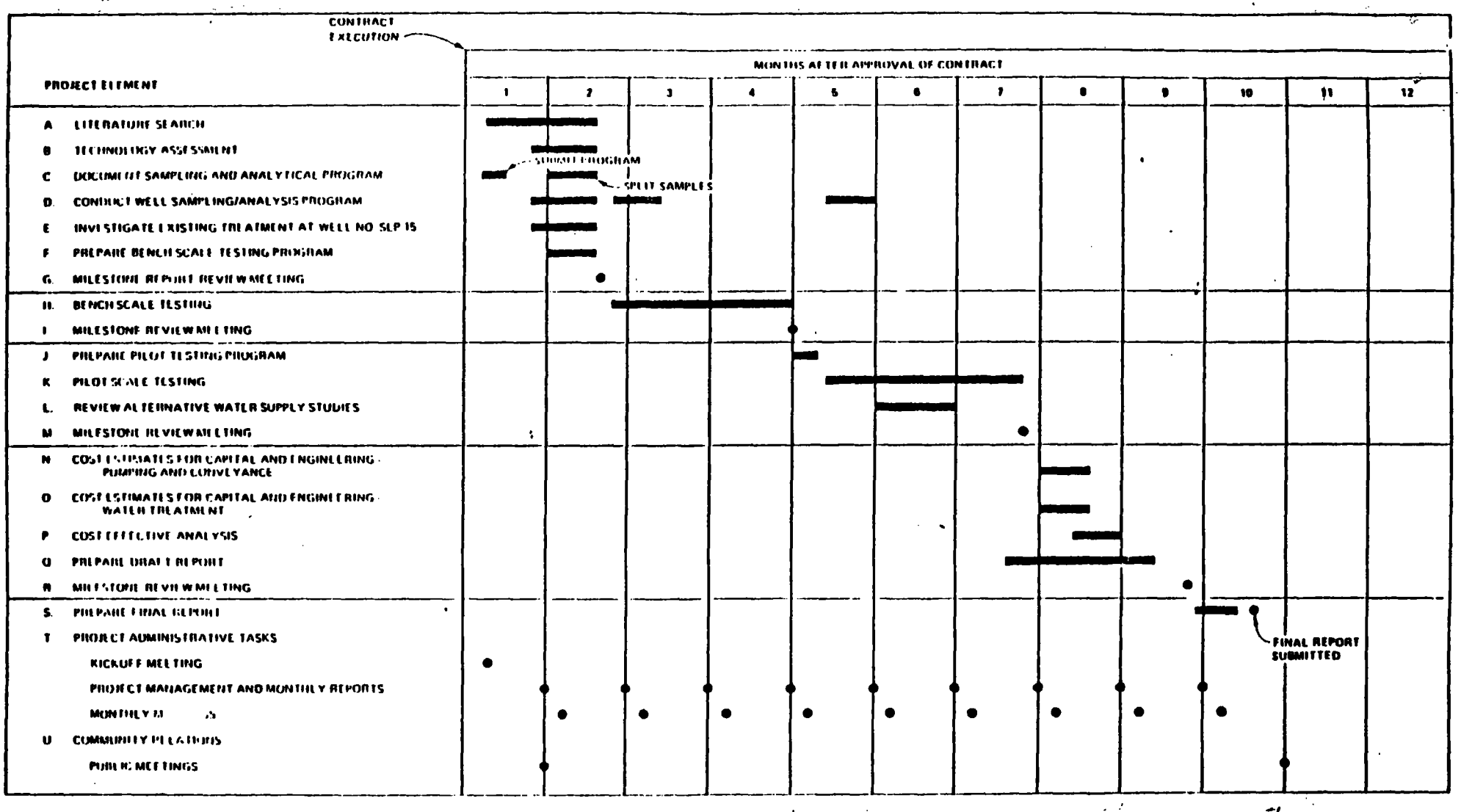
FIELD SAMPLE CODE (FSC)	BRIEF DESCRIPTION	DATE	TIME(s)	SAMPLER

Figure 3. Field Tracking Report Form.

CHAIN OF CUSTODY RECORD

			SAMPLERS (Signature)						
STATION NUMBER	STATION LOCATION	DATE	TIME	SAMPLE TYPE: Water	Comp	Grab	Air	SEQ NO	NO OF CONTAINERS	ANALYSIS REQUIRED
Relinquished by: (Signature)			Received by: (Signature)						Date/Time	
Relinquished by: (Signature)			Relinquished by: (Signature)						Date/Time	
Relinquished by: (Signature)			Received by: (Signature)						Date/Time	
Received by: (Signature)			Received by Mobile Laboratory for field analysis: (Signature)						Date/Time	
Dispatched by: (Signature)		Date/Time	Received for Laboratory by:						Date/Time	
Method of Shipment:										
Distribution: Orig - Accompany Shipment 1 Copy - Survey Coordinator Field Files										

Figure 4. Chain of Custody Report Form.



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ATTACHMENT E
PRELIMINARY PROJECT SCHEDULE
GROUNDWATER TREATMENT
ST. LOUIS PARK, MINNESOTA

Attachment D
SAFETY PRECAUTIONS

A. General Safety Considerations

1. Objectives

The handling and sampling of hazardous waste and other hazardous/materials always poses a certain degree of hazard. The objective of this section is to assure the safety of persons handling hazardous materials though the use of proper safety equipment and proper working habits. The section includes material on: (1) the responsibilities of employees with regard to safety; (2) types of exposure to hazardous waste; (3) initial hazard assessment; (4) emergency treatment; (5) long term risks from exposure; (6) safety equipment; (7) decontamination and disposal of protective clothing; (8) guidelines concerning the safe handling of hazardous waste; and (9) an annotated list of references.

2. Responsibility of Employees

During onsite investigations of any hazardous waste handling facility, safety precautions are paramount to all other considerations because of the extreme dangers posed by hazardous waste. Despite thorough preparation, an employee may not have adequate knowledge of site conditions. It is impossible to anticipate every hazard that could arise. Therefore, the employee should use common sense, judgment and experience. In all considerations related to safety, the employee is responsible for:

- knowing all safety guidance and practices;
- using the "buddy system";
- maintaining safety equipment in good condition and proper working order;
- using safety equipment in accordance with guidance received, labeling instructions, and common sense;
- refraining from activities that would create additional hazards (e.g., smoking);

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- o maintaining safety consciousness--when in doubt, follow the safest course of action; and

- o preventing loss of life, injury or health hazard in the investigation.

B. Types of Exposure to Hazardous Substances

In order to assure the safety of all employees, all exposure to hazardous substances must be protected against and minimized. The purpose of the following information is to provide some insight into the manner by which harmful substances may enter the body. These are four basic routes of entry: inhalation, skin absorption, ingestion, and eye contact.

1. Inhalation

Breathing a gas, vapor, mist, fumes or dust (chemicals may be trapped on particles) is the most common accidental form of exposure and this route of entry is the most likely cause of systemic illness. The inhalation hazard depends on a number of factors: the chance that the chemical is use will leak into the air; the concentration present in the air; the volatility of the chemical at ambient temperature; the inherent toxicity of the chemical; other physical properties, such as particle size of mist, fumes, dust; and the length of time the chemical is breathed.

Breathing gases, vapors, mists, dust or fumes from certain chemicals may affect the body in two distinct ways. First, there may be effects on the lining of the air passages of the nose, throat and lungs. This usually results in an irritation and may cause mild burns. Second, there may be absorption of the chemical from the lungs to the blood stream. The blood distributes the chemical throughout the body tissue causing a systemic effect in which the chemical may act as an asphyxiant, a fibrotic, or a carcinogen.

The employee should take the following precautions in entering a site of unknown hazard and/or in sampling from containers of hazardous waste having an inhalation hazard:

a. Sample only in well ventilated areas.

b. Use self-contained breathing apparatus or appropriate respirator. Select respirator based on assessment of hazard (see Respiratory Protection Section).

2. Skin Absorption

Certain chemicals have the capacity to penetrate the unbroken skin and are picked up by the blood stream and distributed throughout the body. Skin penetration is probably the second most common accidental means of entry of chemicals into the body. A combination of gloves, boots, hats, and coveralls should be worn to protect against skin exposure and absorption. Although no clothing is absolutely impermeable to chemical penetration, certain clothing types provide adequate protection against the hazardous materials encountered. These types will be discussed later. In addition to donning proper safety clothing and equipment, the following precautions should be used in inspecting sites which may contain materials hazardous by skin contact:

a. Insure that all skin areas which may be contacted are protected during site work;

b. When taking samples, carefully wipe all residue off the containers after filling them with the sample;

c. After completing the inspection, use proper procedures for removing contaminated clothing while still at the site;

d. Contaminated rags and other disposable items, such as gloves, should be bagged for proper disposal, avoiding skin contact (see Decontamination and Disposal of Protective Clothing).

3. Ingestion

Toxic amounts of hazardous waste may be carried to the mouth and hand when drinking, eating, or smoking. Therefore, these activities must never be carried on during inspections or after inspections until decontamination procedures have been completed. Furthermore, liquids must not be pipetted or siphoned by mouth under any circumstances.

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4. Eye Contact

The eyes may be harmed by chemicals in solid liquid or vapor form. Irritant effects vary in degree from mild to severe. Most chemicals have the ability to injure the eye to some degree through surface contact or absorption. The following precautions to avoid eye injury should be taken upon entering a site:

a. Wear chemical goggles or face shield (without side perforations);

b. Do not rub eyes when sampling;

c. Never wear contact lenses when working in areas where hazardous materials may be encountered. Contact lenses cannot be work with self contained breathing apparatus or respirators.

C. Sampling Health and Safety Program - Groundwater Contaminated with Creosote/Cresal Mixtures

1. Chemical/Toxicity Data (Sax, N.E., Dangerous Properties of Industrial Materials).

CREOSOTE COAL TAR. Syn: creosote oil. Colorless or yellow clear, oily liquid. Composition: a mixture of phenols from coal tar. bp: 200°-250°, flash p: 165°F (CC), d: 1.07, autoign. temp.: 637°F.
THR = MOD irr via oral and inhal routes. A recog carc of skin, forearm, scrotum, face, neck and penis. An expec carc of the lungs.(14)

Fire Hazard: Mod, when exposed to heat or flame. Reacts violently with chlorosulfonic acid.(19)

Disaster Hazard: Dangerous; when heated to decomp, emits tox fumes.

To Fight Fire: Water may be used to blanket the fire; dry chemical, mist, fog.

CRESOL. Syns: cresylic acid, cresylol, tricresol. Description (U.S.P.XVI): mixture of isomeric cresols obtained for coal tar, colorless or yellowish to brown-yellow or pinkish liquid, phenolic odor. $C_6H_4OHCH_3$, mw: 108.10, mp: 10.9°-35.5°, bp: 191°-203°, flash p: 178°F, d:

1.030-1.038 @ 25°/25°, vap. press: 1 mm @ 38-53°, vap. d: 3.72. Acute tox data: Oral LD_{50} (rat) = 1454 mg/kg.(3) THR = MOD via oral and inhal routes. Cresol is similar to phenol in its action on the body, but it is less severe in its effects. It has corrosive action on the skin and mu mem.

Systemic poisoning has rarely been reported, but it is possible that absorption may result in damage to the kidneys, liver and nervous system. The main hazard accompanying it s use in industry lies in its action on the skin and mu mem, with production of severe chemical burns and dermatitis.

Fire Hazard: Mod, when exposed to heat or flame.

Explosive Hazard: Slight, in the form of vapor when exposed to hear or flame. Reacts violently with HNO_3, oleum, chlorosulfonic acid.(19)

Explosive Range: 1.35% @ 300°F.

Disaster Hazard: Dangerous; when heated to decomp, emits highly toxic fumes; can react vigorously with oxidizing materials.

To Fight Fire: Foam, CO_2, dry chemical.

2. Protective Equipment Required

a. Level B - To be used at Well W13

(1) Personal Protective Equipment

- o Full face-piece air-purifying respirator equipped with an organic vapor cartridge
- o Chemical protective
  - oo Overalls and long sleeved jacket, or
  - oo Coveralls
- o Gloves, inner (surgical type)
- o Gloves, outer, chemical protective

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- o Boots, chemical protective
- o Booties, chemical protective

Level C - All Wells other than Well W13

Personal Protective Equipment

- o Gloves, inner (surgical type)

3. Decontamination and Disposal of Protective Clothing

In leaving a contaminated site, appropriate procedures must be carried out for safe packing of protective clothing. Sequences will depend upon several variables that must be worked out in advance. An optimal sequence is as follows:

1. Remove booties.
2. Remove exterior protective equipment.
3. Remove respirator.
4. Removal disposal gloves.
4. Remove coveralls.

Protective clothing should be folded or turned inside-out, placed in a plastic bag, sealed, and disposed of offsite. Face shields, goggles, respirators, rubber gloves (non-disposable), and rubber boots should be washed between uses.

Decontamination procedures should be worked out, and all required equipment should be available before entry into a contaminated area.

Suggested material and equipment for a personal decontamination station include:

- o containers of rinse water;
- o towels or Kimwipes;
- o enough plastic bags to double bag all disposal items.

ATTACHMENT F

1. Compensation: A fixed fee of $13,140, plus time, materials, freight and other costs at the rates set forth below.

CH_2M Hill Professional Services*	$102,830
Expenses Incurred by CH_2M Hill**	86,115
Barr Engineering Company	
-Professional Services	22,780
-Expenses	9,425
-Fixed Fee	2,735
-5 Percent Markup	1,745
TOTAL COST	$225,630

*See attached Table 4
**Includes $8,200.00 travel and subsistence

2. Reimbursement for travel and subsistence expenses actually and necessarily incurred by Contractor in performance of this contract in an amount not to exceed Eight Thousand Two Hundred Dollars ($8,200.00); provided that Contractor shall be reimbursed for travel and subsistence expenses as set forth in paragraph 2, Attachment A of this contract.

3. Contractor shall submit monthly invoices for its work and subcontracted work which shall include costs incurred for that period of time. Invoices shall include:

-the number of hours charged and the tasks to which those hours were changed for each employee assigned to the project, labor classification, hourly rate, and total charges for the month

-fixed fee due during current month (if appropriate)

-expenses, broken down by category, and listed on the invoice

-subcontract costs, documented with invoices

4. Payment will be made within thirty days of the invoice with exception of the first invoicing which will require additional time to initiate the method of processing. The final payment will not be made to the Contractor until the state's authorized agent and federal OSC have signed off that the work set forth in Contractor's duties of this contract has been completed to their satisfaction.

5. For the purpose of monthly billing, the salary and general overheads shall be those Defense Council Audit Agency (DCAA) approved rates in effect at the time services are performed (currently 166 percent of raw salary). Upon completion of a final corporate audit for any calendar year, a credit or payment shall be made to correct the payment for work performed during said calendar year on cost reimbursement type elements.

6. The state and Contractor recognize the uncertainty of conditions in this project. In the event that the Contractor, in the course of its work, encounters conditions not anticipated at the time of this contract, it shall notify as soon as practicable the state's authorized agent of such conditions and of any resulting changes in the costs to Contractor of completing the tasks under this contract. Contractor and state shall discuss at the earliest opportunity any amendments to this contract relating to the newly discovered conditions. The state shall promptly respond to any requests for amendment to this contract.

Table 4

ESTIMATED COST TO COMPLETE BASE SCOPE OF WORK
(Fixed Fees and Subcontract Markup not Included)

Project Element	ESTIMATED MANHOURS		ESTIMATED COST OF PROFESSIONAL SERVICES		ESTIMATED EXPENSES			Total Estimated Cost for Project Element
	CH2M HILL	Barr Engineering Co.	CH2M HILL	Barr Engineering Co.	Travel, Subsistence and Freight	Laboratory Testing	Miscellaneous Costs	
A. Literature Search	108	---	$ 4,120	---	---	---	$ 600	$ 4,870
B. Technology Assessment	32	---	1,520	---	---	---	50	1,570
C. Document Sampling and Analytical Procedures	28	8	1,110	320	---	2,100	100	3,630
D. Conduct Well Sampling and Analysis Program	68	89	2,720	2,460	1,050	16,320	4,250	26,800
E. Investigate Existing Treatment at Well No. SLP-15	40	8	1,600	150	100	2,700	---	4,550
F. Prepare Bench-Scale Testing Program	32	4	1,560	160	---	---	50	1,770
G. Milestone Report/Review Meeting	64	8	2,760	530	300	---	150	3,740
H. Bench-Scale Testing	964	24	36,610	620	2,050	28,120	9,550	76,970
I. Milestone Review Meeting	24	---	1,120	---	300	---	50	1,520
J. Prepare Pilot Testing Program	28	---	1,320	---	---	---	50	1,370
K. Pilot-Scale Testing	344	120	14,400	4,040	3,100	11,500	5,000	40,040
L. Review Alternative Water Supply Studies	12	92	420	2,610	---	---	50	3,080
M. Milestone Review Meeting	16	12	780	790	300	---	50	1,920
N. Cost Estimates for Water Conveyance Systems	12	156	420	4,730	50	---	50	5,250
O. Cost Estimates for Water Treatment Systems	144	---	6,550	---	---	---	200	6,750
P. Cost-Effective Analysis	80	---	1,060	---	---	---	100	1,160
Q. Prepare Draft Report	180	20	7,160	1,130	---	---	300	8,590
R. Milestone Review Meeting	20	8	810	530	300	---	50	1,710
S. Prepare Final Report	72	4	2,820	260	---	---	1,000	4,080
T. Project Administrative Tasks	168	52	7,430	1,400	2,100	---	100	11,230
U. Community Relations	96	16	4,250	1,050	1,000	---	200	6,500
TOTAL FOR BASE SCOPE OF WORK	2,532	629	$107,830	$22,780	$10,850	$62,740	$21,950	$221,150

GL747/30

*Includes $8,200 for travel and subsistence; $2,650 for freight

ATTACHMENT G

Payments are to be made from federal funds obtained by the state through Title I of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (Public Law 95-510 U.S. Code 42USC9601) and through Title I of the Resource Conservation Recovery Act of 1976 (Public Law PL94-580 U.S. code 42USC6901 and amendments thereto).